High-Resolution Imaged-Based 3D Reconstruction Combined with X-Ray CT Data Enables Comprehensive Non-Destructive Documentation and Targeted Research of Astromaterials

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Introduction: Providing web-based data of complex and sensitive astromaterials (including meteorites and lunar samples) in novel formats enhances existing preliminary examination data on these samples and supports targeted sample requests and analyses. We have developed and tested a rigorous protocol for collecting highly detailed imagery of meteorites and complex lunar samples in non-contaminating environments. These data are reduced to create interactive 3D models of the samples. We intend to provide these data as they are acquired on NASA's Astromaterials Acquisition and Curation website at http://curator.jsc.nasa.gov/ .

Methods: Using calibrated, professional photographic hardware, photogrammetric principals and off-the-shelf image-based 3D reconstruction software, we have established a procedure to create highly accurate, image-based 3D models of astromaterial samples (an inherently non-destructive technique), which can be manipulated by the user to traverse the sample's surface and enlarge its scale [1]. In our initial test we demonstrated imagery resolution equal to 60 microns, and with further refinement to our data collection system, we calculate that we can achieve twice this preliminary resolution. The data can then be combined with 3D volume X-ray computed tomography (CT) data of the samples acquired by micro X-ray CT scanning systems. X-ray CT is a non-destructive imaging technique which provides a complete volume data set of the sample where the data values represent X-ray attenuation, which is to first order dependent on the density (composition) of the material [2].

Results: Together, these data models (high-resolution imagery and X-ray CT) provide a complete surface and interior map of the sample, and a useful tool to explore samples remotely by both the general public and by researchers who require targeted information and context for requesting and analyzing samples. We anticipate that this new set of data and 3D models will also enhance sample preservation and curation because samples requests can be more specific, and curators and researchers can actively negotiate allocations using them [3]. This technique has great potential for refinement and may be especially useful for preliminary examination protocols for new sample return missions.

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